FROM TRADITIONAL TECH LICENSING TO ENTREPRENEURIAL TECH COMMERCIALIZATION

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Abstract

60+ university spinouts in 3 years. 94% still alive. Lowest cost per spinout in the US. The 'book' on successful technology transfer is to find multiple ways to substitute bottom-up entrepreneurial approaches for top-down bureaucratic mechanisms . However, few programs successfully manage the transition to entrepreneurial mode. How did they succeed where so many do not?

We present an overview of the new University of Utah program where spinouts have skyrocketed (the stats above). We share the key facets of their multiple entrepreneurial approaches that converged on their current success, supported by theory and evidence from other successful programs that will give the audience critical 'lessons learned' and a deeper understanding of how other institutions can deploy this constellation of entrepreneurial mechanisms. How does Utah (and other top programs) put entrepreneurs first? How can we replicate their success?

Etzkowitz (2008) shows that despite the press and PR, the median TTO loses money – probably more than is usually known. Only a handful regularly generate significant positive cash flow. How do they differ?

We offer here a set of key principles for successful technology commercialization, illustrated by a very recent exemplar, that of the University of Utah. As opposed to a case study where the story unfolds and key best practices identified en route, this essay builds a model for successful technology commercialization organized into five key elements. For each element, we then describe the Utah model in those terms, followed by lessons for application elsewhere.

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The Five Elements

We categorize these into five areas that a successful technology commercialization program requires. While this list is obviously neither complete nor exhaustive, it nonetheless focuses on strategies and tactics that are within the control of those managing it. One cannot count on having a Nobel Laureate, but we can play to our strengths and maximize what intellectual assets we do have.

Leadership: Use the 'bully pulpit', make sure leaders fully understand what it takes. And be clear in your strategic intent.

Understanding and Managing the Context: Here, some programs are more blessed than others but even absent a munificent environment, there are positive options.

Changing the Culture: Increasing market orientation, strategic focus on commercialization and, most importantly, increasing the entrepreneurial climate and training to support and sustain the culture change

Engage the Ecosystem: Improve connectors, align resources, engage internal stakeholders, take advantage of students.

Leadership in the Process: Empower the professionals, insist on private sector leadership, and develop the right metrics

I. Leadership

Successful technology commercialization begins with leadership – visible, vocal leadership. Leadership that establishes clear vision and missions for technology commercialization.

a. Bully Pulpit:

One thing that always characterizes an effective entrepreneurial organization or an effective entrepreneurial community is that leaders make a visible effort to demonstrate their support for entrepreneurial activities. Vocal leadership is still more critical than generally recognized. What they say, however, and how they say it matters too. The new President of the University of Utah, Michael Young, made it a clear priority that the institution will drive economic development. He backed that statement up with a new organization structure that removed the commercialization office from under the VP for Research and aligned it with the Business School and its entrepreneurial programs. Business School Dean Jack Brittain, was promoted to run the new organization Technology Ventures, and given freedom to build a new and interactive program.

b. Understanding:

Leaders need to show that they understand what they are advocating. Do they need to understand the intricacies of technology commercialization? No, but they do need to show that they understand the importance of the effort – and the consequences of failing. As with any strategy, visibly informed support by key leaders has lasting impact.

c. Strategic Intent:

Universities and major research laboratories face multiple strategic mandates, often conflicting. Some are formal directives, but some are local cultural norms that are perceived as

administrative mandates. Leadership can serve the process well simply by clarifying what is -and what is not – expected. Some university admininstrators perceive (or express) a mandate to avoid commercialization. (See for example Derek Bok's *Universities in the Marketplace: The Commercialization of Higher Education*.) However, even if this is not the real mandate, it is perceived as such by key actors in the technology commercialization ecosystem.

Hamel and Prahalad (1994) argued that successful organizations need a clear strategic intent to guide the activities of the organization and its members. Shane's work (2005) suggests that leadership is a key ingredient that cannot be readily quantified.

Utah's Experience:

Utah had a tech-savvy, tech-friendly governor who made it a matter of key policy to encourage technology development. Through a focused lobbying effort from the Dean of the Business School, the case was made for attracting well funded, world-class entrepreneurially minded faculty that could collaborate in translational research areas that matched the State and University's current clusters of expertise. The stated intent of the program was to use a portion of the State's budget surplus to fund a new collaborative research center and hire new "high-value" research faculty on an ongoing basis; Governor Jon Huntsman and the legislature agreed to significantly fund this program.

On top of that, the University of Utah's new president supported the concept, and argued that most of the new funding should be dedicated to technology development. The President also named a tech-savvy, tech-friendly business school dean in the chain of command. (One interesting move by Dean Brittain was to banish the phrase "tech transfer" in favor of the more proactive term "technology commercialization" as a clear signal that business-as-usual was ending, and that the culture **will** change.)

Finally, a new Director of Technology Commercialization began a broad, concerted effort to connect with and engage every stakeholder in technology commercialization, every member of the entrepreneurial ecosystem, the media and the University's internal constituents. Since this these changes approximately four years ago, key leaders in government and the university have kept an open door and have to fostered continuous communication to stakeholders.

Lessons & Prescriptions:

Wishful thinking: Find and elect/appoint the right leaders.

Entrepreneurial thinking: Educate your leaders, reinforce their support wherever possible (and start nurturing future leaders.)

The media can be a powerful leverage point. When one can read about "burn rates" in the *San Jose Mercury News* – on a sports page! - you know you are in an entrepreneurial local culture.[2] Never miss opportunities to share your "great stories" with the media, but do not miss the same opportunities to share with stakeholders inside and outside your organization (e.g., others in the entrepreneurial ecosystem).

Most of all, note that there was a clear strategic intent conveyed clearly and repeatedly by leadership.

2 John Doerr. Interview transcript, undated.

II. Context

Obviously, some environments support technology commercialization more readily than others. Arvids Ziedonis's (e.g. Mowery, et al. 2001, Ziedonis 2007) illustrates some patterns when university spinouts proliferate (and where they do not). Ziedonis observed that there were more spinouts where there were more experienced founders available and where science and technology classes included a commercialization focus. There were more spinouts where there was an obvious local/regional industry cluster for that technology, which provides greater tacit/local knowledge of the industry and the local business community. Interestingly, spinouts were also higher in highly uncertain environments (e.g., where research funding was less secure). Spinouts were lower where there was less access to complementary assets and complementary technologies (as the lack of cluster suggests) and less access to critical resources such as financing.

a. Munificent Environment:

Resources matter, both tangible and intangible. These resouces can be provided both by the institution and by strong community engagement.

Ample resources afford more room for experimentation (or mistakes). Excessive and unfocused resources also attract unhelpful attention, e.g., those who will have incentive to pursue any new funds.[3]

Also, even with a great bounty of intellectual property, it is important to focus on those areas where local competence already exists externally (e.g., a local industry cluster) and potential synergies exist internally. This both maximizes knowledge spillover – in both directions – but also helps to forge a cohesive identity (e.g. Acs, et al. 2007; Audretsch 2007).

b. Backlog:

While it never hurts if there is pent-up demand for what you are selling, it is equally valuable to have a large pent-up supply to meet that demand. In this case, technology commercialization can move much more easily if there is a large number of potential technologies available to commercialize. For example, this can provide the program with some quicks "wins" to further legitimize their efforts (and the mechanisms being used.).

c. Frustration?:

What can be even more critical to success, however, is ready access to potential entrepreneurs. Having potentially commercializable technologies is a necessary but not a sufficient condition. A university needs access to entrepreneurs who are eager to begin the process but are frustrated at the system's ability to impede and render commercialization efforts moot. As we discuss below under "Culture" the entrepreneur is essential.

Embracing strategic change frequently occurs with two key elements. First is intense dissatisfaction with the *status quo*. At some point, even highly risk-averse administrators embrace change. The second key is confidence that the new course of action is feasible. I will adopt a new technology if I am unhappy with what I have now and my self-efficacy at using the new alternative is positive.

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3 Recall the *Finding Nemo* seagulls: "Mine, mine, mine"

Utah's Experience:

The new initiative at the University of Utah was saddled with burgeoning IP costs, a massive portfolio, frustrated faculty and a need for more creative sources of funding. Utah was, however, blessed by the quantity of quality, successful research that was generating significant intellectual property that needed a refocused outlet and a collection of entrepreneurial science and engineering faculty that lacked an obvious outlet.

Again, we observe that as the new technology commercialization program unfolded, Utah found potential entrepreneurs coming out of the woodwork. They also began gently teaching faculty and administrators about the realities of entrepreneurial activity.

Utah quickly identified several areas where they could focus their efforts and build centers of excellence. These centered around medical applications, nanotechnology, imaging and energy, including cleantech. These already are becoming part of the university's identity

Lessons and Prescriptions:

Munificent Environment: Budget surpluses are rare enough; add in the political will to invest it in new directions and it is not a controllable event. (Nor is there any guarantee that funds will continue to flow.) However, remember that **in**tangible resources are also critical. Having an entrepreneur-friendly cognitive infrastructure is something that is within our control, even if tangible resources are scarce. Thus, building an entrepreneurial culture becomes vital if a technology commercialization program is to be sustainable.

Critical Mass: What if a school or lab lacks a pre-existing critical mass of intellectual property? First, there may be more IP available than one realizes. Formal mechanisms for invention disclosure may not be present nor encouraged. In fact, the researcher need not even realize that their work is potentially commercializable. This presents a golden opportunity to educate researchers about this. (See "Training" below.)

Second, programs can aggregate demand. In the case of Utah, there are more active researchers than any two Idaho schools. However, a state like Idaho can aggregate their intellectual property to build the needed critical mass. (Add in the large federal Idaho National Lab [www.INL.gov] and the aggregated IP should be more than ample.)

Nationally, the filing of new patents has doubled over the past five years or so leading to a massive excess of intellectual property. AUTM estimates that almost 70% of university IP will go unlicensed or wasted (not counting the IP that never gets disclosed). This presents a clear opportunity for bundling and co-marketing of overlapping IP.

Supply of Potential Entrepreneurs: What if you don't have a supply of potential entrepreneurs? First, you may have more than you realize (as with the technologies themselves.) Second, you can to grow your own. Entrepreneurial training can be very effective in science and technology settings. Third, the entrepreneurial talent need not be the scientist/engineer (who might still prefer to remain in Academe and/or in the laboratory). With the right partnering, a scientist need not take the entrepreneurial reins to get a new technology to market. In fact, the failure of faculty leaving the University to start a company

represents one of the highest failure rates of any currently measured metrics. The value of proper entrepreneurial education and training cannot be overstated enough and the creation of, even grass roots, programs are critical to the establishment of a robust technology ecosystem.

However, all of this illustrates again the importance of growing a strong culture that supports and encourages entrepreneurial activity.

III. Changing the Culture

"Changing the culture" is too often a mantra for any new program, especially where new directions are imperative. However, that begs two questions. First, what would that new culture look like? Second, how do we go about changing the culture? Let's start by addressing the first question while we address the second question in later sections.

Why should a more entrepreneurial approach matter? Consider the problem of commercializing a new idea. The "fuzzy front end" (e.g., Koen, 2001) of technology commercialization features the development of marketable ideas. Narayanan (2007) maps this as "T-P-M". That is, we develop new products (P) in the messy space where the features of a new technology (T) are translated into the benefits desires by potential buyers in markets (M). What does it take to find the connections where market desires match features of new ideas? The answer is not "what" but "**who**" - it takes someone to figure out the opportunity, it takes the unique skills of "entrepreneurs." This means that not only do we need entrepreneurs at the very heart of technology commercialization, we need entrepreneurial thinking through the technology commercialization ecosystem.

So what would an entrepreneur-friendly culture look like? How would be know it?

a. Market Orientation:

It's not too much of an oversimplification to argue that organizations (and their members) tend to either focus on what they are producing and on what their stakeholders desire. That is, does the organizational culture exhibit a "product orientation" or a "market orientation"?

In this case, we would look to see whether a university is more concerned about protecting their intellectual property or more concerned about commercializing it. For example, which is seen as the greater risk:

- the risk that a technology reaps an insufficient (or zero) return? Or...
- the risk that a viable technology doesn't get commercialized at all?

One key marker of this is often more subtle. Does the institution focus on what the technology should do for users or on what potential users actually want? For example, Von Hippel (1984) found extensive evidence that often the #1 source of great innovations was the customer. More important, Zucker and associates (2002) found that there are times that IP must flow from industry to academe, so keeping strong, open links is vital.

All this suggests that the entrepreneurial community needs to be engaged and engaged fully across the life cycle. The more potential users (and licensees) that get a close look at the technologies, the better. Does the university make strong proactive efforts to demonstrate viable

value propositions to users or simply "put it on the shelf" for "browsing"?

b. Focus on "Fundamental Research"

Each research university faces the question of research focus on fundamental research. This decision, however, is more nuanced than frequently recognized. What a faculty member in biochemistry may define as applied research may well be appropriate as a fundamental research area for a professor of chemical engineering. Faculty both in chemistry and chemical engineering may find baffling how scholarly activity in architecture or art fall into their definitions of fundamental research.

Another interesting aspect to consider is that research that leads to commercialization is not (by definition) second-class research. Curiosity based research is viewed as appropriate, while research performed with the additional expectation of serving society in the short term ("commercializable research") can even be referred to as a violation of the research ethos (as most recently chronicled in a *New York Times* article condemning Bayh-Dole[4]). The proper emphasis should be in the terms of scholarly activity that is appropriate in each academic discipline.

In this light, Dean Brittain's change of title from "tech transfer" to "tech commercialization" seems much less trivial.

Acs and associates (e.g. Acs et al. 2007) noted how Ireland took the strategy of focusing all research dollars into **(a)** areas that supported local industry cluster development and **(b)** was applied research. The seemingly abrupt shift away from basic research was not greeted fondly by universities, but it was an essential component of the "Irish Miracle."

c. Entrepreneurial Orientation:

Considerable research has tested a model that argues the entrepreneurial organization exhibits three necessary attributes. Entrepreneurial organizations are proactive, accepting of risk and uncertainty, and innovative. While strongly bureaucratic organizations such as universities have institutional (and possibly statutory) constraints on being truly entrepreneurial, they can support entrepreneurial individuals and subunits.

Another way to look at this is whether the organization formally and informally supports and nurtures entrepreneurial thinking. That is, is the bias toward seeking and acting on opportunities, or is the greater concern toward threat-avoidance?

Cornelia and Jan Flora showed how entrepreneurial communities are characterized by a broad set of enabling social and cultural conditions [*entrepreneurial social infrastructure*] that support entrepreneurial thinking and entrepreneurial action (Flora & Flora 1993). Krueger (2000) argues that where entrepreneurs and potential entrepreneurs perceive an entrepreneur-friendly environment [*cognitive infrastructure*] that encourages the identification of personally-viable opportunities, we do see greater quantity – and quality – of entrepreneurial thinking and action. These authors also stress that increasing entrepreneurial intent is not the goal, the goal is to create an informed intent based on expert (not novice) entrepreneurial thinking.

d. Understanding Entrepreneurial Dynamics:

This too is an important marker. Everyone in the technology commercialization

4 The Bayh-Dole Act was legislation enabling universities to legally commercialize intellectual property developed using institutional resources.

ecosystem must recognize the realities of the entrepreneurial process. One key element of this is that the needs of a new venture vary dramatically across its life cycle. While this seems obvious, we occasionally lose sight of this. Davidsson & Klofsten (2003) show significant strategic differences between ventures that have found their initial footing, a basic "platform". Every firm that launches and grows faces the melodramatically, but accurately named "Valley of Death". Programs need to help them before, after and especially during this risky transition.

Randall Goldsmith developed a model that mapped out 18 stages of a new venture where across each of six phases of the life cycle we can separately examine the needs and key deliverables for the market, technology/idea and venture dimensions of a new business. For example, a business plan isn't actually appropriate until stage 9. At each stage entrepreneurs' needs will vary sizably: Different kinds of advice and information, different sources of funding, etc.[5] Given the differing needs across the life cycle, programs need to identify resources for each stage and ensure that the ventures get connected.

e. Training and Development:

How do we grow a more entrepreneurial climate? One obvious answer is to provide training not just on the basics of technology commercialization but also entrepreneurship training – and across the entire ecosystem. Formal classes and intensive immersion experiences (a/k/a "boot camps") are popular and can be highly effective if timely and well-designed.

Simply showing people the simple mechanics of a business plan can actually reduce entrepreneurial learning. What participants need is genuine experiential learning that provides them with critical developmental experiences that help them moves from novice toward expert as entrepreneurial thinkers. However, facilitating the expert mindset requires facilitators who have that mindset (Krueger 2007, 2009), another argument for making sure that programs keep this professional (section V) and to , again, engage entrepreneurs.

Utah's Experience:

Before and after the creation of the new technology commercialization program at Utah, the new program and those participating in it do seem to be more proactive, more tolerant of high uncertainty, and more comfortable with more discontinuous innovation. Absent strong measures, it also seems to exhibit a greater orientation toward opportunity seeking. This represents an untapped arena for rigorous research (see below). This sense of an increased entrepreneurial orientation is particularly reinforced by the committed engagement of the program with a broad, rich array of community partners that grow a healthy entrepreneurial ecosystem.

The University of Utah assessed its current programs and built opportunities along the invention value chain from invention to company maturation involving both faculty and students. Some of the programs include:

1. Technology Titans (Science idea competition)
2. Lassonde New Venture Development (scholarships to upwards of 30 graduate students to assess U of U technologies
3. Faculty Mentoring Program
4. Entrepreneur-in-Residence

5 For the full model, see http://www.bsutecenter.com/tools

5. Executive- in-residence
6. Launch Pad
7. Student Venture Fund

Lessons & Prescriptions:

A technology commercialization effort would seem to thrive in a setting with a strong entrepreneurial orientation, however defined, and probably where the orientation was increasingly entrepreneurial (but that is a subject for future research, as is the question of whether the orientation can be excessively entrepreneurial.)

However, given the bureaucratic intensity of almost any university, it may be enough for the technology commercialization program itself to exhibit a strong entrepreneurial orientation.

IV. Engaging the Ecosystem

We often hear that "it takes a village" to nurture new entrepreneurial ventures, that there is an entrepreneurial ecosystem that supports (or inhibits) the growth of entrepreneurial activity (Audretsch 2007; Flora & Flora 1993; Krueger & Brazeal 1994; Krueger 2000). The same is true for technology commercialization.

Of great recent vogue, especially in Europe, is the clever metaphor of the "Triple Helix" that posits that effective innovation systems are characterized by the committed presence of three key institutional actors: Government, Academe and Industry [business community]. If these three actors are firmly in place, we have the necessary conditions for entrepreneurial activity (Etzkowitz 2007).

On the other hand, this top-down institutional model has no room for the heroic entrepreneur myth. While this correctly notes that entrepreneurship is indeed a team sport, it falls very much under the "product orientation" mindset noted above.

Consider the DNA helix metaphor: DNA is far more than the strands; the critical information in a DNA molecule rests in the cross-linkages. So too with entrepreneurial development. Only the cross-linkages are themselves inherently entrepreneurial. Figure 1 takes a bottom-up, functional view where entrepreneurial assets (people) and innovation assets (resources) are complexly interconnected by bridging assets (Krueger, et 2008; Camp 2005).

Evidence suggests that the Triple Helix "works" in that successful efforts appear to have the three institutions firmly in place, however, it says little or nothing about how the innovation system evolved into successful form. In fact, evidence is growing that ignoring the linkages can be fatal (Krueger, et al. 2008; Brannback, et al, 2009**).**

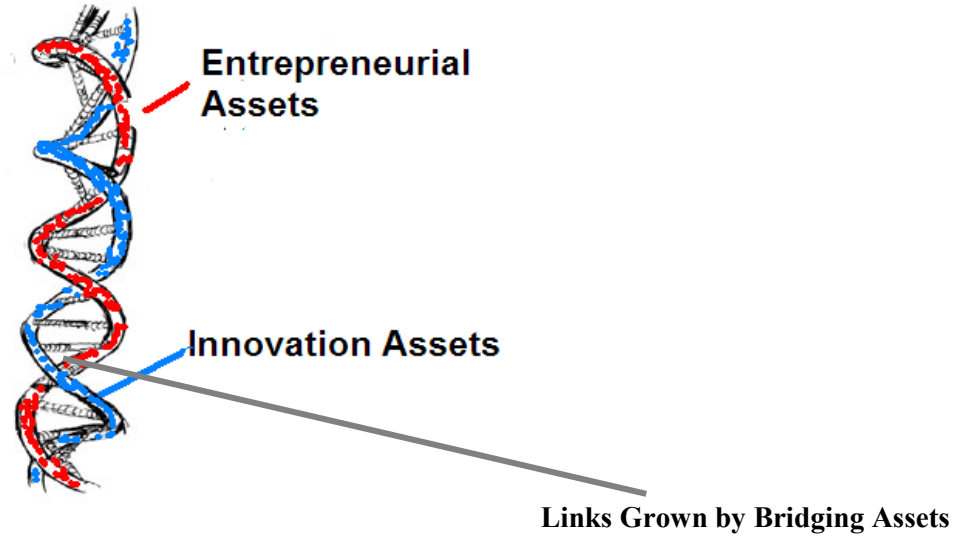

Figure 1. The entrepreneurial helix

a. Connectors:

It seems patently obvious the ecosystem in which new technologies evolve is complex and dynamic, no doubt nonlinear, discontinuous and highly, highly uncertain. No matter what tangible resources might be available to develop a new technology into a viable new venture, the people involved need to be connected to those resources in a complex, dynamic, altogether messy process that is unlikely to routinized and institutionalized.

As such, successful innovation systems require "bridging assets" that serve to connect people, ideas and resources. And these bridging assets are typically humans: Passionate, proactive professionals whose mission is to connect. Gerry Sweeney (1987) dubbed them "*liaison-animateurs*."

Interestingly, many key connectors are not doing this as a formal job task. Informal connections are often critical. Stephenson (2008) found for the city of Philadelphia that the city's 200+ key connectors did not overlap with any list of the city's "most influential" - in fact, they often occupied very unlikely roles. Connecting is hard to monetize so programs need to be alert as to how to reward connectors who are often motivated intrinsically.

On the other hand, consider the example of three US Department of Energy national labs[6] who have a formal "Entrepreneur-in-Residence" who happens to be a partner in a major venture capital firm. Imagine the access to resources (not just funding), advice and contacts. Imagine the signals that sent across their respective technology commercialization ecosystems by having an in-house partner of Kleiner Perkins.

The "care and feeding" of connectors is critical to the success of any innovation system and technology commercialization programs need to identify, nurture and if possible reward their connectors (Krueger 2008; Brannback, et al 2008).

b. "Alignment":

Typically, defining the scope and nature of what needs to be done is only the first stage

6 Livermore, Oak Ridge and Sandia

of implementing a program. In economic development circles, the process is identifying a draft "road map" then finding ways to align resources optimally to implement the road map (e.g. Pages 2001).

Again, typically, this can be highly contentious as the various players have strong preferences for what they should be doing. However, alignment requires that participants identify where they add the most value. This is often not even the top strength of a given participant (and almost always not what they most want to do). Again, modeling the connector mindset can be invaluable (though here is another place where the leaders' bully pulpit can come into play to great effect.)

One interesting mechanism to align resources is the "proof of concept" center where there is a dedicated program established to walk entrepreneurs from idea to the proof of concept stage (e.g. Gulbranson & Audretsch 2007; Litan, Mitchell & Reedy 2007).

c. Internal Stakeholders:

Georgia Tech and the University of Illinois credit much of their success to selling the value of an entrepreneurial approach to technology commercialization to all members of the academic community, not just faculty and a few top administrators. Having the staff understand all of this can lead to friendlier receptions for paperwork. The merits of engaging the school's fund-raising arm and the alumni association are obvious. Even where the stories are probably apocryphal it is a clear signal that technology commercialization is valued greatly (e.g., at a prominent West Coast university, reputedly but unconfirmably, the school's venture capital investment fund endows the football team.)

d. Students Are Our Secret Weapon:

Trying to identify what potential user wants might map onto the features of new technologies requires multiple observers with highly diverse knowledge sets, skills and experiences and the willingness to think highly creatively. Many programs have used even undergraduate students (even non-business, non-science majors) to assess the commercialization potential of new technologies. The TRAILS program at the Idaho National Lab used student teams to identify potential licensees for their newly-patented work (Krueger 2005). The TEAM program at Colorado uses student teams to assess, even market their new cleantech developments. [7] The number of these programs has grown globally.

Other ways to engage students in technology commercialization is through vigorous competitions. The more-traditional business plan contest has not been terribly effective, nor are they terribly inclusive, so the University of Texas created a global competition where students take relatively raw intellectual property ("idea") and through several iterations develop the idea into something genuinely marketable ("product"). This Idea to Product® (I2P®)[8] competition is a recent, but fast-growing model for an effective way to both provide genuine experiential learning to participants and to accelerate the commercialization of new ideas. For example, the US Department of Energy's Oak Ridge National Laboratory offers a large regional I2P® event,[9] and I2P® programs have been offered in Asia, Europe, Africa and South America.

I2P® is a perfect example of how engaging the entire ecosystem professionally reaps

7 See http://ei.colorado.edu for more
8 See http://ideatoproduct.org for more
9 See http://www.globalventurechallenge.com

huge dividends. Moreover, the I2P® process is also a perfect example of the kind of truly experiential learning that grows expert entrepreneurial thinking where the more routine competitions clearly do not (Krueger 2007, 2009).

Recognition of the value of deploying students has been recognized by key supporters of entrepreneur development. The National Collegiate Inventors & Innovators Alliance (NCIIA) is a significant champion, coach and funder of university programs where cross-campus student teams learn technology commercialization experientially. NCIIA also developed a blueprint for technology entrepreneurship boot camps called "Invention to Venture" (I2V).

The Ewing Marion Kauffman Foundation has also funded a wide range of entrepreneurial projects that support directly or indirectly technology development. For example, there are multiple "Kauffman Campuses"[10] where cross campus entrepreneurship was heavily supported with the proviso that entrepreneurship be defined as transdisciplinary and that it run by people with genuine expertise and credentials. (All Kauffman program directors are both internationally-recognized entrepreneurship scholars and educators and significant personal entrepreneurship experience. Kauffman, NCIIA, NSF, et al argue that a program needs both to be successful and to get funded.) This echoes the earlier point that it isn't about nurturing entrepreneurial thinking, it's nurturing **expert** entrepreneurial thinking.

Utah's Experience:

Utah embraced an entrepreneur-centric (a clear market orientation) mindset from the outset, intentionally and methodically. They also offered a seat at the table for any potential connector, even those entities notorious for "not playing well with others." Perhaps more important, the director and staff quite mindfully served as passionate, proactive, professional connectors themselves, modeling the desired behavior. Getting all the right people around the table and modeling the connector mindset and behaviors made alignment relatively easier. However, having the vocal, visible support of the Governor, legislature, and university president is unlikely to have been a barrier.

Lessons & Prescriptions:

Again, identifying, nurturing and rewarding the connectors is critical to any innovation system. This may place a program at odds with powerful institutional stakeholders, however the modeling of healthy connector behavior is valuable at least in the long run.

Engaging everyone possible is not easy; engaging everyone willing to 'play well together' is worth it. This should include the less-obvious stakeholders such as university staff.

Engaging students is extraordinarily useful, even though it means yielding considerable creative control to them. However, the track record is such that this might be one of the "no-brainers" for technology commercialization efforts – students really are our secret weapon.

Universities that lack the critical mass of IP to develop a formalized proof of concept center can (as noted in section II) partner with other institutions in a joint venture.

10 A sampling: University of Illinois, Wake Forest, Florida International, UTEP, North Carolina

Programs should also look to engage external supporters from the National Science Foundation (e.g. Partnerships for Innovation) , the Kauffman Foundation, NCIIA and others. Each provides much more than possible financing, they provide advice and information.

Finally, this is a solid opportunity for leadership to help align resources more optimally and to celebrate the process.

V. More on Leadership: Supporting the Process

Technology commercialization begins with leadership; it ends with leadership too. The bully pulpit of visible, informed support is critical but that leadership needs to support the range of activities that we know encourage technology commercialization. We have provided an overview of proven mechanisms (grounded in sound theory) that any institution can emulate. These are the strategies and tactics that the leaders should espouse and champion.

However, the implementation of these strategies and tactics requires three more points that, once again, the Utah case illustrates.

a. Professionals:

Earlier, we noted that the best connectors are "passionate, proactive professionals." The third "P" is just as critical. Even beyond the obvious need to maintain precise (yet imaginative) compliance with legal and institutional requirements, the other participants in the entrepreneurial ecosystem are unlikely to be impressed by clever amateurs, especially when it comes to investing significant time and money to a technology commercialization effort of any kind.

Similarly, a program requires genuine experts at all key leverages points such as training, whether students or staff. However, the Kauffman Campuses experience shows that ambitious programs see this as a golden opportunity to recruit top entrepreneurship scholars and educators who also have entrepreneurial expertise.

"Professional" is too often no more than a label. In an entrepreneurial setting, rife with improvisation, it is tempting for those trying to help the process [such as technology commercialization programs] to join in the "fun" and mirror the complex, dynamic, even chaotic behaviors. And while technology commercialization professionals must embrace the uncertainty, they must also embrace the need of other stakeholders for legal compliance and maintaining the integrity of the process.

b. Private Sector Leadership:

Entrepreneur-centric programs seem to work best in almost any development setting. Whether we look at rural microenterprise development or high-stakes technology commercialization, the system always seems to function better and more sustainably when it focuses on the entrepreneurs and their champions, not on the institutions.

For example, even under the top-down "triple helix" model, one of the three critical institutional actors is "Industry". What we know about any kind of entrepreneurial development tells us that the business community needs to be at least *primus inter pares* and take leadership in supporting the entrepreneurs as key focus. Moreover, the private sector tends to have a much clearer understanding of how important bridging assets are to growing businesses.

Successful programs like Stanford or Texas or Colorado (or Utah) fully embrace the entrepreneurial community to a degree that it is fully part of the local culture, both university and community.

c. Develop and Use the Right Metrics:

Yet another seemingly obvious prescription but it is vital that commercialization efforts be thoroughly transparent if they are to build credibility with all its stakeholders. Moreover, metrics must address the right outcomes, including intermediate outcomes (such as those monitoring the process). Note that qualitative goals and metrics may actually be needed, especially in the early stages of growing a technology commercialization program (Etzkowitz 2008) but stakeholders demand transparency in how these 'soft' measures are designed and used.

Utah's Experience:

Like many of the most successful technology commercialization programs, the Utah program is relentlessly inclusive, even demanding of the business community to take leadership – and accept the requisite responsibilities. And, like many of the most successful technology commercialization programs, the Utah model manages to appear as both sharply professional and cheerfully entrepreneurial. At places like Texas, Stanford, Colorado (and Utah) the technology commercialization professionals are perceived as entrepreneurs themselves.

Also, by setting measurable goals of engagement of the venture community, angel groups, existing businesses, CXO's and state government, the University of Utah TCO was able to drawn in the necessary resources and focus that attention squarely on the entrepreneurs creating both a culture and foundation for growth. Professionalism pays off.

Key Conclusions

The final section above in many ways summarizes all the foregoing observations. Programs such as Utah's pulls together many of our known best practices at entrepreneurial development in ways that seem a natural fit with one another.

* Embrace the community in a truly engaged fashion.
* Focus on the entrepreneur.
* Focus on connectors, on bridging assets
* Talk the talk.
* Walk the walk.
* Play to your strengths (we all can't be Stanford or MIT don't focus on what they do, focus on local resources, technologies and entrepreneurial capital).

It is not easy to change the mindset but if a program wants to succeed, it's the only way. However, the foregoing suggests that the success of programs like Utah and others have is within their grasp.

In short, it is very hard indeed to create entrepreneurial activity from a bureaucratic mindset. Technology commercialization can only be done effectively from an entrepreneurial mindset and an expert mindset at that. The best technology development programs – and the best technology development people - really are entrepreneurs.

For the future:

We have already suggested some high-payoff areas for future research. We intend to develop this research agenda further but welcome others to explore these fascinating (and important) issues.

For example, from a case study perspective, we certainly can identify other successful programs to test their fit with the principles outlined above. (We can also look at less-successful programs to assess their lack of fit. In particular, we need to identify successful programs that deviate significantly and less-successful programs that nonetheless meet these criteria.)

We also assume that there are other critical leverage points that we have neglected and exploring programs that do not fit this model will be especially fruitful.

We can also begin measuring various aspects of entrepreneurial orientation in programs and in their institutional contexts (how does an entrepreneurial business community matter?) We can also attempt to extend the model, e.g., to incubators, where the common presumption is that "more entrepreneurial" incubators do better.

More ambitiously, we see this framework as the basis of a prescriptive model for technology commercialization *per se*, but we would remiss if we did not recognize that we would be building on the work of many others that inspired this framework (e.g., recent reviews by Link et al 2007; Phan & Siegel 2006).

Finally, we would be equally remiss to ignore the need to adapt this framework for practical application. That effort is already underway.

In sum:

Guy Kawasaki in his ubiquitous presentations on his "Art of the Start" (2004) always closes with his 11th Commandment: "Be a Mensch." A mensch is someone who does the right things the right way and for the right reasons. While he was referring to entrepreneurs, this advice applies just as strongly to technology commercialization programs. From the foregoing, it seems clear that doing the right things the right way for the right reasons also pays off in success at technology commercialization.

Recall: 60 spinouts. 3 years. Cheaply. We offer here a model that explains much of this success and how others may replicate their success.

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